AMENDMENT UNDER ARTICLE 34 PCT (clean copy)

AMENDED CLAIMS

[Received at the Receiving Office on June 21, 2005 (21-06, 2005): Claims 1 and 10 as originally filed, and Claims 2-9, and 11 as amended under Article 19 PCT have been amended; Claims 12-13 have been newly added. The page 2 of the original specification has been amended as shown in substitute pages 2 and 2-1]

1. (Amended) A method of measuring a superficial chemical species which comprises the steps of:

irradiating a white light to a biological surface as a sample;

detecting a spectrum of the white light reflected from two or more positions on said biological surface;

plotting an absorbance of said spectrum to a spectral multi-dimensional space of light;

conducting a multivariate analysis of a data on said spectral multi-dimensional space obtained from said two or more positions to obtain eigenvectors of at least first, second and third principal components;

projecting the data of each position onto a direction of the eigenvector of at least one of said principal components except said first principal component to measure at least one of the concentration of the superficial chemical species on said biological surface and a concentration difference therebetween, based on a magnitude of the component of said data with respect to the direction of said eigenvector.

2. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein at least one of the amounts of a plurality of the superficial chemical species and a concentration difference therebetween is measured from one spectrum of light.

3. (Amended) The method of measuring a superficial chemical species according to claim 2, wherein said plurality of the superficial chemical species include oxygenated hemoglobin and reduced hemoglobin.

4. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein said multivariate analysis is conducted with said spectrum of light having wavelength bands of from 500 to 600nm and 500 to 850nm.

5. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein said multivariate analysis is conducted with said spectrum of light having wavelength bands of from 500 to 600nm and 700 to 780nm.

6. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein said multivariate analysis is conducted with said spectrum of light having wavelength bands of from 500 to 600nm, 500 to 850nm and 700 to 780nm.

7. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein said multivariate analysis is conducted with a wavelength band including an

absorption wavelength band specific to melanin; and

a melanin concentration is predicted from a score of an eigenvector corresponding to melanin and a calibration curve of a score obtained from a sample whose melanin concentration is known.

8. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein a light-sensitive substance is administered to said biological surface so that said multivariate analysis is conducted with said spectrum of light having basic wavelength bands of from 500 to 600nm, 500 to 850nm and 700 to 780nm, further including a wavelength band specific to said light-sensitive substance.

9. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein talaporfin is administered to said biological surface so that said multivariate analysis is conducted with said spectrum of light having a basic wavelength band of from 600 to 700nm.

10. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein said multivariate analysis is conducted with said spectrum of light having a basic wavelength band of 700nm or above.

11. (Amended) The method of measuring a superficial chemical species according to claim 1, wherein said multivariate analysis is conducted with said spectrum of light having basic wavelength bands of from 500 to 600nm and 500 to 850nm, while a data of at least one position on said biological surface is projected onto the directions of the eigenvectors of said second and third principal components 1to display a change of magnitude thereof with time.

12. (Newly added) An apparatus for measuring a superficial chemical species comprising:

a means for irradiating a white light to the superficial chemical species as a sample;

a means for detecting a spectrum of the white light reflected from two or more positions on said superficial chemical species;

a means for plotting an absorbance of said spectrum to a spectral multi-dimensional space of light;

a means for obtaining eigenvectors of at least first, second and third principal components by conducting a multivariate analysis of data on said spectral multi-dimensional space obtained from said two or more positions; and

a means for displaying a magnitude of the component of said data on a gray scale or in colors according to the magnitude, on a two-dimensional screen by projecting the data of each position onto a direction of the eigenvector of at least one .of the principal components except said first principal component to measure at least one of the concentration of the superficial chemical species on said biological surface and a concentration difference therebetween, based on the magnitude of the component of said data with respect to the direction of said eigenvector.

13. (Newly added) The apparatus for measuring a superficial chemical species according to claim 12, wherein said means for irradiating a white light is provided integrally with a means for condensing reflection from two or more positions on said superficial chemical species sample by combining them with an optical fiber.

[0005]

A method of measuring a biological surface according to a first aspect of the invention comprises the steps of:

irradiating a white light to the biological surface as a sample;

detecting a spectrum of the white light reflected from two or more positions on said biological surface;

plotting an absorbance of said spectrum to a spectral multi-dimensional space of light;

conducting a multivariate analysis of a data on said spectral multi-dimensional space obtained from said two or more positions to obtain eigenvectors of at least first, second and third principal components;

projecting the data of each position onto a direction of the eigenvector of at least one of said principal components except said first principal component to measure at least one of the concentration of the superficial chemical species on said biological surface and a concentration difference therebetween, based on a magnitude of the component of said data with respect to the direction of said eigenvector.

[0006]

According to the above measuring method, all the spectra reflected from each position of the biological surface used as a sample are detected to allow them to undergo statistical data processing, no filter is needed. Further, since the condition of a biological surface is measured and displayed by comprehensive analysis of a wide range of data, it is effective to decrease errors in detecting pathological changes.

In the foregoing measuring method, at least one of the amounts of a plurality of the superficial chemical species and a concentration difference therebetween may be measured from one spectrum of light. Further, said plurality of the superficial chemical species may include oxygenated hemoglobin and reduced hemoglobin.

[0007]

Further, since the multivariate analysis is conducted with a basic wavelength band of light used for data processing ranging from 500-600nm and 500-850nm, it is effective for observing, for example, dialectical peripheral vascular obstruction syndrome or the implantation condition of a transplanted skin after a skin transplant operation, and errors in detecting pathological changes can be lessened.